Predictive Accuracy of Political Stock Markets

Empirical Evidence from a European Perspective

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Abstract

In a meta study of 25 political stock markets conducted in Germany in the last decade we analyze their predictive success. Although the predictions of political stock markets are highly correlated with the corresponding polls, the markets are able to aggregate additional information. One explanatory variable for variations in predictive success of the German stock markets relative to the polls is market efficiency. Even though the overall predictions of the political stock markets are quite reliable on the aggregate level we find systematic prediction errors on the contract level that can be attributed to the vote share size and to individual trader biases.

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1. Introduction

During the last decade a rising interest in using political stock markets to predict electoral outcomes could be observed. This is at least partially due to the overwhelming predictive success of several early U.S.-markets organized by the pioneers of policial stock market research, the Iowa Electronic Markets.[1] Inspired by this success a growing number of political stock markets were conducted within Europe. Altogether the European markets seem generally to generate higher average prediction errors than their American counterparts. This might be due to the fact that the well performing American markets usually cover a lower number of traded contract types as a consequence of the different political systems. Thus, when trying to judge the predictive accuracy of European markets it might be more adequate to compare the European market forecasts to polls.

When reviewing the European results the picture is mixed. A number of markets outperformed pollsters, others did not. Jacobsen et al. (2000) reported a series of 5 markets in the Netherlands that did not perform better than polls. This is also true for an Austrian market on the EU referendum on whether or not to join the European Union (Ortner et al., 1995). Brüggelambert (1999b) reviews several German markets that were not very successful in predicting the election outcome in comparison to pollsters. On the other hand Bohm and Sonnegard (1999) report a market on the EU referendum in Sweden that was more precise than the polls and Ortner et al. (1995) survey positive results from Austrian vote share markets. There are also reports on German political stock markets that outperformed polls (compare e.g. Berlemann, 2000). Several explanations have been provided for the somewhat lower degree of success of European markets compared to the U.S. markets as, for example, differences in the political institutional structure (Jacobsen et al., 2000) and the complexity of the markets (Berg et al., 1997).

In this meta study we try to answer the following questions within an European context: (1) Do political stock markets predict the outcome of elections more accurate than polls? (2) Can we identify factors that determine the accuracy of political stock markets? (3) Are there systematic prediction errors in political stock markets on the contract level, in particular individual party effects and vote share size effects? To answer these questions we use data of 12 years of German political stock market research, including 25 markets and 45 final poll results for 3 federal elections and 11 state elections. We selected this sample because in the German system of proportional representation the same parties run for office on all different election levels. In addition to the analysis on the aggregate scale this allows us to test for systematic biases on the contract level, what might not be feasible using a sample of all European political stock markets. Our focus is on the main implications of the theoretical model of Jacobsen et al. (2000) that parties with a large vote share tend to be underpriced in election markets and those with low vote shares to be overpriced. Our comparatively large sample allows us to test this hypothesis empirically.

Since political stock markets did not perform out traditional polls in every single election we also use the German data to identify factors that determine the accuracy of the market forecasts compared to polls. Berg, Forsythe and Rietz (1997) found the number of different contract types (a proxy for the election level) of a market to be the most important factor in explaining predictive accuracy of American data. Since the number of different contracts traded in the German markets does not vary on a large scale there is room for further explanations of predictive accuracy.

[1] Jacobsen et al. (2000), Table 1, p. 207, report a mean absolute error for the four largest North-American markets of in between 0.2 and 0.5.

Our main results can be summarized as follows:

- We find a highly significant correlation between the predictive accuracy of political stock markets and published polls measured by the mean average error. Yet, the markets were able to aggregate additional information and outperformed polls slightly. This result is significant on the 10% level when using a squared error measure.

- An explaining factor of the superior predictive success of the German stock markets relative to the polls is market efficiency, defined as the price difference of a unit-portfolio on the primary and the secondary market.

- Even though political stock markets predict well on the aggregate level we find systematic prediction errors on the contract level that can be attributed to the vote share size and to individual trader biases. In particular we find that small contracts are systematically overvalued whereas large contracts are undervalued.

The following negative results might also be of interest:

- The predictive accuracy for major elections is not higher than for state elections.

- Number of traders, level of monetary investment and duration of the market do not determine predictive accuracy of political stock markets.

- There is no significant correlation between the degree of dispersion of the vote shares, measured by the so-called "Theil-Index", and predictive accuracy of political stock markets.[2] Thus the theoretical argument, put forward by Jacobsen et al. (2000), that the

[2] In addition to that the coefficient of the Theil index has the wrong sign in our empirical analysis.

relatively poor performance of the Dutch markets were primarily due to the above mentioned systematic prediciton errors is at least not true for the German markets.

The organization of this paper is as follows. In Section 2 we describe the data that consists of 25 German political stock markets and the corresponding polls. An evaluation of predictive accuracy of traditional polls versus political stock markets follows in Section 3. We then revisit the question of what factors influence predictive accuracy of political stock markets in Section 4. Finally we test for systematic prediction errors on contract level in Section 5. Open research questions for further exploration and concluding remarks are presented in Section 6. The Appendix offers an introduction to the political system and the political parties in Germany.

2. Data description

Before we turn to the formulation and tests of the different hypotheses in the following sections we should describe the data. Principally we rely on two sources of data. On the one hand, we use data generated by 25 German political stock markets for 14 different political elections. The data includes final contract prices as well as market properties. On the other hand we rely on poll data published in the aftermath of these elections. Table 1 provides an overview on the political stock markets and the polls which are included into our sample.

Table 1 about here

2.1 Basic features of the data

To our knowledge the first German political stock markets were conducted in 1990. The latest results are from markets that were conducted on the occasion of two state elections in March 2001. All German political stock markets that covered federal and state elections were included into our sample. To the best of our knowledge our sample covers all German political stock markets. Several educational and commercial institutions conducted political

stock markets in Germany. This implies that various software systems and several market institutions have been used. Most markets have been run via the IEM which implement a continuous double auction market institution. If not stated explicitly we always refer to IEM-style political stock markets.

For each election with at least one political stock market we collected poll results that were published shortly before election eve. We included all published polls that were conducted on a scientific basis by political opinion research institutes. If there were several polls by the same institution we always included the latest poll that was typically conducted a week before election day. To the best of our knowledge we cover with our sample all final polls.

Similar to Berg et al. (1997) all markets in our sample were organized as vote share markets. Different from the US-sample, our data is quite homogeneous with respect to the number of contracts that were traded within the markets (the number of contracts was in between 5 and 7).[3] This is due to the fact that the parties that run for office in federal elections are typically involved in state elections, too. Most of the markets were real money markets where traders had to invest an initial amount of money in order to get admittance to participate. These markets were organized as zero-sum games: all money invested was paid back to the participants. Only two of the German political stock markets have been run as so called "fantasy markets".[4] These markets run without money investment of the participants. A few traders with the best performance received valuable goods as rewards whereas all the other traders were not (monetarily) rewarded.

The way of reporting about the final prediction of the market differs among the various market organizers. In a perfect market environment the best predictions are the last traded

[3] Typically the organizers include separate contracts for parties that are expected to be represented in parliament. All other parties are combined in the "Rest of Field"-contract (RoF). The PDS party was included in 16 markets as a separate contract, the Republikaner party in 7.
[4] Federal Election 1994 (WirtschaftsWoche), Nordrhein-Westfalen 2000 (Wahlfieber).

prices right before the market closes. The economic interpretation would imply that all information is included into these prices. To avoid possible manipulations of the closing prices some organizers of political stock markets report a weighted average of the last 24 hours in the later markets. In addition, we often observe imperfect markets where the market closing prices do not add up to 100%. For example, the forecast of the 1990 federal election market in Leipzig added up to 96.1% for all different contracts. As a result, some market organizers employed a normalization procedure of the vote shares when they reported their results. We should also note that our sample is somewhat heterogeneous with respect to the closing time. Some markets closed on the day before election, some were open until the polling stations were closed.

2.2 Political stock markets in Germany

During the federal election in 1990, four political stock markets were running at the Universities of Bonn, Frankfurt/M, Leipzig, and Saarbrücken. The markets have been installed on the local sites and were open during regular working days. In Frankfurt, where right after the federal election a market on the Hessen state election in 1991 was conducted, a network enabled version of the software has been used that attracted 62 participants during a period of one month. The small stock market in Saarbrücken (4 trading days/21 participants) used - contrary to the continuous double auction of the parallel markets - a posted offer auction market institution.

For the 1994 federal elections, the first German political stock market via Internet has been installed in Regensburg. The market attracted 400 participants who could trade 7 days a week and 24 hours a day during a 5 month period (Brüggelambert, 1999a). The Passau political stock market that also covered the 1994 Bavarian state elections has been installed with a call market institution (Beckmann and Werding, 1996). This market opened on specific trading days where buy and sell orders were collected and a uniform price for every party was

generated in the end of a day. The political stock market of the WirtschaftsWoche, a German weekly, used a similar organization of the market. Here, participants were not asked to invest their own capital; instead the traders with the highest yield were rewarded with valuable goods.[5]

The first commercial political stock market via Internet has been conducted by Wahl$treet for the newspapers "Die Zeit" and "Der Tagesspiegel" on the occasion of the 1998 Sachsen-Anhalt state elections. Even though the prediction of the state election result was far off the actual outcome Wahl$treet conducted the next stock market during the 1998 federal elections. It was so far the largest market with 9482 participants. Up to this time Wahl$treet restricted the maximum investment per participant to about 5€. The IEM stock market for the 1998 federal election has been installed at the University Halle-Wittenberg, where 112 academic participants traded on the outcome of the election.[6]

Since then, 8 state elections have been covered by political stock markets. Most of the markets have been conducted by academic institutions (Hessen 1999, Sachsen 1999, Berlin 1999, Baden-Württemberg 2001, Rheinland-Pfalz 2001), the earlier markets by Wahl$treet (Hessen 1999, Brandenburg 1999, Berlin 1999, Nordrhein-Westfalen 2000), and the later ones by Wahlfieber/Prognosys (Schleswig-Holstein 2000, Nordrhein-Westfalen 2000, Baden-Württemberg 2001). At this point, a convergence in various features of the markets can be observed: all markets used the continuous double auction as market institution, the trader accessed the markets with a standard Web browser via the Internet, and the average investment of the participants was 19.07 € per market.

[5] If participants were purely interested in material rewards, this obviously inspires risky investments and possibly crazy market outcomes.

[6] We did not include the so-called "WahlDax" conducted by the financial daily newspaper "Handelsblatt" on the occasion of the 1998 federal election due to the fact that the reported "market prices" were based on a simple questioning of the participants (Handelsblatt, 1998).

2.3 How to measure predictive accuracy

Let us now briefly discuss the common practice of measuring predictive quality of the markets and the poll forecasts. In most of the empirical studies concerning political stock markets, the mean absolute error (MAE) of the forecast is used to assess predictive accuracy (Berg et al., 1997, p. 452)

$$MAE = \frac{1}{K}\sum_{i}^{K}\left|v_i - \hat{v}_i\right| \tag{1}$$

where K is the number of parties (including the "Rest of Field" (RoF)) and v_i is the true vote share of party i. It might be argued that a different measurement should be applied (Brüggelambert, 1999a, p. 45). Since we deal with forecasts on election outcomes it might be better to have small prediction errors with respect to all parties than to have a large prediction error on one party and to forecast all other vote shares accurately. This is due to the possibility that large prediction errors might imply totally different possibilities of forming coalitions between the involved parties – what is of great importance especially in the German political system. From this point of view it seems to be reasonable to measure predictive accuracy by the mean squared error (MSE).

$$MSE = \frac{1}{K}\sum_{i}^{K}\left(v_i - \hat{v}_i\right)^2 \tag{2}$$

Since there is – at least from our point of view – no obvious argument in favor of one of the measures[7] we decided to follow Beckmann and Werdings's (1998, p. 755-757) proposal to do all empirical tests with both measures.

[7] The fact that in the majority of polls the published results are rounded to .5 or whole numbers might be taken as an argument in favor of using the mean squared error.

3. Do markets predict better than polls?

One of our basic hypotheses is that political stock markets should be able to predict electoral outcomes more precise than traditional polls. Before we tackle this question empirically we should explain why we believe in this hypothesis. Therefore, we first outline the basic setup of political stock markets and German pollsters. In a second step we state our hypothesis. The final subsection presents the empirical results.

3.1 Political Stock Markets

Political stock markets typically are fully computerized futures markets organized on the occasion of political elections.[8] To take part in a market participants have to register first. Principally there are no formal restrictions for admission. Nearby all markets are real money markets, i.e. traders regularly have to cover their initial investments on their own. This implies that participants have a monetary incentive in that they can win or loose money depending on their trading success. Due to legislative restrictions the maximum investment per trader is typically limited. Trading takes place over the Internet and is possible 24 hours a day and 7 days a week during the market period. Contracts are put into circulation via „unit-portfolios“ that can be bought from or sold to the market organizer at any time during the market period (primary market) for a predefined price (typically 1 Euro). Unit-portfolios bear no risk since they can be sold back to the market organizer at any time. To win or loose money the participants have to trade with other market participants (secondary market). The contracts traded within political stock markets have liquidation values tied to the results of political elections. All election markets in the sample are so-called „vote-share-markets“, i.e. the liquidation value of a certain contract depends on the share of votes of the party. After closing the market each participant gets the liquidation value of his portfolio plus the cash he holds on his market account. This liquidation procedure (all initial investments are paid back

[8] A more detailed description of the prototype of political stock markets, the Iowa Electronic Markets (IEM), can be found in Berg et al. (1997).

to the participants) assures that conducting election markets is a zero-sum game for the market organizer.

3.2 Polls

Political opinion research on the basis of scientific methods started in the 1930's in the United States and evolved in Europe (especially in France, Great Britain and Germany) only a few years later (Worcester, 1983). The basic question of this area of research is "who voted for whom and why". Election forecasts, i.e. a quantitative prediction on the election result, are - similar to political stock markets - only a by-product of political opinion research. The methods that are used to forecast differ from country to country, depending on aspects like the political system and political culture. In the following we focus on the German system. In Germany the quality of an election forecast typically depends at least on three factors: the representativeness of the sample, the quality of the ascertained data and the procedure that is used to correct the raw data to gain the final forecast.

A prerequisite for the success of traditional polls is a representative survey sample. Such a sample is hard to obtain. Bohm and Sonnegard (1999) suppose misrepresentation problems to be one of the major explanations for why polls failed in predicting the outcome of certain elections. In political opinion polling two basic methods are used to obtain a representative sample: the random method and the quota method. The random method demands that each element of the population gets into the sample with the same likelihood or at least with some likelihood (Roth, 1998, p. 68). Under the quota method there are some ex-ante requirements that have to be fulfilled by the sample because it is expected that these characteristics are also given for the population. To be able to formulate these requirements there is a need for reliable information on the population. There is no consensus which of the sample methods is superior with respect to political opinion research (King, 1983). From a theoretical point of view the random method seems to be preferable because no information on the population is

needed. Nevertheless, it is nearly impossible to organize a perfect random sampling at some reasonable cost. For example, within oral surveys it can not be ruled out that the interviewer contacts primarily persons he is able to contact easily. This would clearly offend the principles of the random method. The same is true within telephone surveys because the population of telephone owners might differ from the one of voters.[9] Because of these problems pollsters like Allensbach Institute of Opinion Research often use the quota method (Hentschel and Tennstädt, 1985, p. 28). If the procedure is carried out properly the result of the quota method is a good substitute for a random sample. Taking into account that interviewers typically are paid on the basis of interviewed persons it is somewhat doubtful whether the resulting sample is really comparable to a random sample (compare Diekmann, 1995, pp. 343-345). Since quota sampling induces unrepresentative samples and random sampling is expensive many pollsters start with quota samples in the first surveys and switch to random samples as the election eve is getting closer.

The second decisive factor for the accuracy of traditional polls is the quality of the ascertained data that itself depends on factors like the questioning technique, the survey method and the time when the survey is done. Experiences of the Allensbach Institute (reported by Hentschel and Tennstädt, 1985) have shown that

- the so-called "secret ballot technique" where the voting act is simulated was much less reliable than using the so-called "Sunday-Question" ("For whom would you vote if election day would be next Sunday"),
- it is better to give a list of possible answers to the interviewed person than to ask "open" questions,
- the reliability of the data increases the closer the election day is,

[9] While in Western Germany 98% of all households own a telephone this quota is only 85% in Eastern Germany.

- it is useful to categorize the interviewed person with respect to the probability that they in fact will go to vote on election day.

Additional factors for the quality of the ascertained data are the number, formulation, and order of the questions as well as the communicative abilities of the interviewer. Altogether the reliability of the data increases the more standardized the interview is done.

Experiences have shown that the raw data of the interviews have to be corrected to obtain some reasonable election forecast. In Table 2 we show data of the Allensbach Institute on the 1980 federal election in Germany. It is easy to see that using the results of the interviews without correcting them would have caused a very inaccurate forecast for the CDU party. In fact all German pollsters make use of some correction procedure, though it is hard to obtain at least some information on how the correction is done precisely.

Table 2 about here

The Allensbach Institute suggests that the preferences revealed in the interviews differ from the true preferences because of the so called "pressure of the climate of opinion". It has been noted that, if one party is quite popular during conducting a survey, there is a bias among people with preferences towards other parties to reveal their true preferences. Thus it is necessary to measure the actual climate of opinion to correct for this bias. An additional instrument to increase the forecasting quality is to use so-called "recall questions", i.e. to ask for which party the interviewed person has voted in the last election. This allows to infer the number of staunch supporters of a party from the recall questions and eases to estimate the necessary corrections of the raw data.

3.3 Comparison and Hypothesis

We now turn to the question why we expect political stock markets to deliver more accurate forecasts than traditional polls. A first argument in favor of political stock markets focuses on the aspect of the representativeness of the sample. While there is a strong need for a representative sample with respect to the demography of the likely voters in polls, it is often claimed that there is no need of a representative group of traders within a political stock market (compare e.g. Forsythe et al., 1995, p. 773), since the traders in a political stock market have not to reveal their own political preferences at any point in time. To be successful in trading a trader needs to have good information on the aggregate voting behavior. The resulting trading behavior might be totally different from his personal preferences. Thus, different from polls, the election forecast is obtained by the marginal behavior of the traders (last traded prices) and not by average figures of the vote intention. To produce a good election forecast it is principally sufficient that at least some of the traders are well informed, i.e. the necessary information is available within the market. According to the "Hayek Hypothesis" (Hayek, 1945) the market mechanism will lead to reveal this information in the course of time via publicly observable market prices for the traded contracts. Thus a good forecasting result can be obtained even if the sets of information of the traders are initially asymmetric distributed (Forsythe et al., 1992, p. 1143).

The argument, that a representative trader sample is not a necessary precondition for a good forecast might be questioned in the light of systematic judgement failures occurring on an individual level. The existence of these judgement failures was documented by several authors like Forsythe et al. 1992, p. 1153-1156, and Brüggelambert 1999a, p. 68-75, for single markets. Yet, the question whether individual judgement failures cause systematic biases on the aggregate market level has not been studied. We will focus on this question in section 5.

Altogether we might conclude that representativeness is at least more important in polls than in political stock markets. In fact, it is often reported that the samples of traders in political stock markets were far from being representative with respect to the demography of the likely voters (compare Beckmann and Werding, 1996, p. 178, Brüggelambert, 1997a, p. 258 or Forsythe et al., 1992, p. 1157 and p. 1146). Nevertheless, these markets turned out be quite successful in predicting election outcomes.

A second advantage of political stock markets is that traditional polling methods are much more prone to different types of survey errors. Besides the earlier described errors resulting from problems to generate a random sample we have to take into account systematic errors like non-response-errors and errors that occur when the interview results get recorded. As already described, earlier pollsters try to correct for the third type of errors, the so-called "interpretation errors" by applying different correction procedures to the raw data. Nevertheless, there is no guarantee to get rid of these errors.

A third advantage of the political market design can be seen in the motivation of people who are subject to the measurement of political opinion. Pollsters have to rely on the goodwill of the interviewed persons who have no incentive to reveal their true preferences. Quite the reverse, supporters or sympathizers of extremist parties might be tempted to cover their true preferences. In addition, it is possible that people who are suddenly confronted with the Sunday Question in an interview answer without having considered the question carefully. The latter effect can be suggested to be even more relevant if the interviewed persons are rewarded financially when answering. Even if the interviewed persons are willing to reveal their true preferences there is regularly no possibility to take the intensity of those preferences into account (Forsythe et al., 1995, p. 773). The Allensbach Institute reports that interviewed persons are categorized into three subgroups ("sure", "likely" and "surely not" going to election) to get rid of this problem. The answers of the groups get weighted by 1.0 (sure), 0.7

(likely) and 0.0 (surely not) (Hentschel and Tennstädt, 1985, p. 27). All those problems do not exist in a political stock market because the traders do not have to reveal their personal preferences on the parties running for office at any time. The only, or at least the most important motivation of taking part in a political stock market is earning profits via organizing profitable trades. Since the traders can loose real money in the markets there is some kind of self-selection of the traders: only those traders, who believe to have good information on the election result, take part in the market. This is why non-informed traders have no incentive to enter the market - apart from organizing some arbitrage transactions which increase market efficiency - and thus they do not influence market prices and the election forecast.

Another important advantage of political stock markets is the high periodicity of the forecasts. While it is possible to obtain an actual election forecast from the market at any time during the market period, traditional polls in Germany are organized mostly on a weekly basis during federal elections. Because the data have to be recorded, summarized, and corrected, polls are always somewhat outdated when published. It should also be noted that political stock markets are much less expensive to operate than traditional polls (Forsythe et al., 1995, p. 772).

Finally we should briefly note that traditional polling methods allow to divide the polling results into different socioeconomic subsamples that can be analyzed separately. Thus questions like the voting intention of women or managers can be tackled. Since the participants of political stock markets do not have to reveal their political preferences at any time such research can not be done via market data.

Altogether there are a number of good reasons which underline the hypothesis that political stock markets should be able to predict election outcomes more accurate than traditional polls. We will now turn to an empirical assessment of this hypothesis.

3.4 Empirical Results

To test the hypothesis whether political stock markets generate more accurate election forecasts than traditional polls we compared the average forecast error of the political stock markets to the average error of the published polls for 14 elections. As it was pointed out earlier we use as forecast error measure both MAE and MSE. Whenever more than one political stock market or poll was conducted for the same election we use the average error.

Table 3 about here

It turns out that in 9 out of the 14 elections the average political stock markets performed better than the average poll using the MAE measure. When using the MSE measure in 8 elections the markets outperformed the polls (see Table 3). In one case, the Hessen 1991 state election, the MAE resulted in a tie, whereas the MSE was favorable for the political stock markets. For the 1994 federal elections and the Sachsen-Anhalt 1998 state elections the MAE was smaller for the markets and the MSE was smaller for the polls. When we compute the average error for the 14 elections using the MAE criterion the mean value of the political stock markets is 1.44 (0.78) and the one of the polls is 1.58 (0.77).[10] The difference is marginally insignificant using a one sided paired samples mean test on the 10% confidence level ($T=1.198$; $p<0.126$). The MSE criterion results in an error of 4.30 (5.66) of the political stock markets and 5.20 (5.50) for the polls. Here, the difference of the mean values is significant on the 10% level ($T=1.519$; $p<0.077$).[11]

Both, political stock markets and polls in our dataset were conducted by several different institutions. It might be argued that there are systematic biases in the forecasts of certain institutions, e.g. as the result of differences in techniques or attitudes. Thus it seems to be useful to compare the forecasts of political stock markets and polls that were organized by the

[10] Standard deviation in parentheses.
[11] A non-parametric Wilcoxon Test revealed the same qualitative result for the MAE and MSE criterion.

same institutions. To do so we concentrate in the following on the markets of the German Election Markets Workgroup (GEMW) (10) and Wahl$treet (5) and the (published) poll results of Infratest (11) and Forsa (9). The descriptive statistics of the comparision of the organizing institutions underlines the results of the parametric test: the market organizers had in all but one of the comparisions more often a smaller prediction error. For example, when comparing GEMW-markets with Forsa-polls the markets turned out to be better in 4 cases and the polls in three cases using the MAE criterion. Under the MSE criterion the GEMW-markets were better in only 3 out of 7 cases (GEMW-Forsa 4:3 (3:4); GEMW-Infratest 5:3 (5:3); Wahl$treet-Forsa 3:1 (3:1); Wahl$treet-Infratest 4:1 (3:2)).

It might also be useful to take the point of view of a single market organizer and to ask the question: How does a single market perform compared to the average poll of the referring election? In case of the 25 German political stock markets 16 markets performed better than the average poll using the MAE and the MSE criterion. In one occasion a tie is the result when the MAE criterion is used (see Table 1).

4. What Makes Markets Predict Well Revisited

In this Section we will first summarize hypotheses on variables that might be decisive factors for the accuracy of electronic markets‘ election forecasts[12] and then test these hypotheses empirically. In a comparable study of Berg, Forsythe and Rietz (1997) for American data the following variables were found to be important factors of predictive accuracy: (1) the number of contract types traded in a market (a proxy for the election level), (2) the pre-election market volumes, (3) and the differences in election eve weighted market bid and ask queues. Different from our analysis this study contains no poll data, yet a drawback of our analysis is that we have only a limited set of market properties due to the fact that different institutions have organized the German political stock markets. It should be underlined that – similar to

[12] Captured in the MAE of an election.

the work of Berg, Forsythe and Rietz (1997) - the further analysis is intended to uncover the factors of success of already conducted markets, i.e. we take an ex-post point of view. Since we include data into our regression that can not be observed in advance, as for example the poll error, our results provide little information from an ex-ante perspective when trying to predict the forecast error of a future market. Table 4 gives an overview on the variables we included into our regression.

Table 4 about here

4.1 Election Characteristics

4.1.1 Level of Election

Principally we should expect that the predictive accuracy of a market is increasing with the quality of information traders have on the election. Since the quality of information is hard to measure we have to use some indirect test on this issue. The incentive for the traders to collect additional information decreases ceteris paribus with increasing costs. Our impression is that information on federal elections are much easier and therefore cheaper to obtain than it is the case for local elections. Since the expected value of additional information is nearly the same in markets on federal and local elections we might suggest that the degree of information is higher in federal elections than in local ones. In addition, state elections in Germany are often used to protest against the current federal government thereby increasing electoral uncertainty in those elections (Schöppner, 1994). Therefore, the first hypothesis we test is that the level of the election (federal or local election) has a significant influence on the predictive accuracy of a market. To do so we create the variable „LEVEL“ that is 0 for federal elections and 1 for local elections. According to the above hypothesis LEVEL should have a significantly positive coefficient.

4.1.2 Number of Parties (Contract types)

The second hypothesis we test is that predictive quality of a market depends on the number of contract types traded within the market. It seems to be reasonable to assume that the degree of uncertainty increases with an increasing number of variables to predict (compare Berg, Forsythe and Rietz, 1997, p. 454-455). To test this hypothesis we use the variable „CTYPES" that captures the number of different contract types within the referring market. According to the hypothesis we should expect a positive coefficient for CTYPES. Different from Berg, Forsythe and Rietz (1997) we do not have to take into account possible co-linearity problems between the variables LEVEL and CTYPES because the number of different contracts traded in the markets does not differ systematically between local and federal election markets.

4.1.3 Poll Error

Most empirical studies on political stock markets find a positive correlation between the market prices of the party contracts and actual poll results. Up to now there is no consensus with respect to the question whether polls significantly influence market prices or not. While Forsythe et al. (1992) reject the view that polls drive the market in their analysis of the 1988 presidential election in the United States, Brüggelambert (1997b) finds positive evidence for the hypothesis that polls influenced market prices within German markets.[13] Beckmann and Werding (1996) find only some minor influence of the polls on the prices in their analysis of a political stock market conducted on the occasion of the 1994 federal election in Germany. In our study we do not consider the question of causality. Nevertheless we suppose that traditional polls' accuracy is an instrument for the general electoral uncertainty of an election. From election to election there are different degrees of electoral uncertainty, depending on factors like the number of undecided voters in the pre-electoral period or the general political climate. The polls' forecasting error as a proxy of general electoral uncertainty should be

positively correlated to the market forecasting error. The variable „MAE_POLL“ captures the average absolute error of all available polls for a specific election.

4.1.4 Asymmetric Vote Shares

In a recent paper Jacobsen et al. (2000) report the results of 5 Dutch political stock markets that performed quite poor in predicting election results. To explain this phenomenon they develop a theoretical model of a judgement failure[14] occurring in markets where contracts with different vote share sizes are traded. While the vote shares in American presidential election markets were of comparatively homogeneous size this was not true for the Dutch markets. The implication of the model on the market level is that a larger variability of the contract size influences the prediction error negatively. Because of the low number of Dutch markets the authors were not able to test their hypothesis formally. In our larger sample we are able to conduct this test. Following Jacobsen et al. (2000) we use the so-called „Theil coefficient“ to measure homogeneity of the shares‘ size. The Theil coefficient is defined as

$$Theil = \sum_{i=1}^{N} v_i \cdot \ln(K \cdot v_i) \tag{3}$$

where K is the number of parties and v_i is the true vote share of party i. The coefficient is 0 when all parties have the same vote share and it is one if one party gets all votes. The variable „THEIL“ we include in our empirical analysis should have a positive sign therefore.

4.1.5 Time Effects

In Germany at least the two large parties CDU/CSU and SPD traditionally were supported by very loyal voters. During the last 30 years the support of those staunch voters somewhat eroded. This process was enforced by German Reunification via integrating East German

[13] Brüggelambert (1997) considers two German federal election markets (1990, 1994) and one market on a local election (Hessen 1991).
[14] Different types of judgement failures are discussed in Section 5.

voters with somewhat unstable political preferences. Roth (1998, p. 35) reports that the share of staunch supporters decreased from two-thirds to approximately one half of the voters during the last 30 years. This tendency towards a larger share of floating voters is supposed to make election forecasts more difficult in general. If this hypothesis is true we should be able to observe a somewhat decreasing forecasting accuracy in the course of time. Our sample allows us to test for the hypothesis because it covers more than a decade of political stock market research. To do so we create the variable „TIME“ that captures the number of months the market was conducted after the first election market in our sample, i.e. the markets on the federal election in 1990. According to the hypothesis TIME should have a positive coefficient.

4.1.6 Floating Voters in Eastern Germany

As it was pointed out earlier there is a larger share of floating voters in Eastern Germany. We created a dummy „EAST“ that is 1 for all markets that were conducted on the occasion of an election where East German voters were involved and 0 otherwise. If the share of floating voters in fact influences predictive accuracy we should observe a positive coefficient for EAST.

4.2 Market effects

4.2.1 Number of Traders

It might be suggested that predictive accuracy enhances with an increasing number of active traders. On the one hand, it is more likely that all relevant information is in the market with an increasing number of active traders. On the other hand, the number of active traders might influence the speed with which information is incorporated in the market (Berg, Forsythe and Rietz, 1997, p. 456). Market organizers report the number of registered traders. This number might deviate from the number of active traders, yet, it is a good proxy. To test this

hypothesis we created the variable „TRADERS“ that captures the number of traders in the market. According to the hypothesis we should expect a negative coefficient for TRADERS.

4.2.2 Average Investment

From a theoretical point of view it is important that the transactions within the markets are done on a real-money basis. During the last decade there were a number of political stock markets in Germany that were no real-money markets and it would be an interesting question to analyze whether the real-money markets performed significantly better than the others. Since we only have data for two markets that were conducted on the basis of virtual money we can not test this hypothesis formally.[15] A similar hypothesis is that the financial engagement of the traders plays a decisive role in determining predictive accuracy. The more money the traders invest the more information the traders might expect to have on the election result.[16] Thus, we should be able to observe good predictions in markets with high per trader investments. The variable „INVEST“ captures the real-money investment per trader (0 was assigned to the virtual money markets). According to the hypothesis we should expect a negative coefficient for „INVEST“.

4.2.3 Total Investment

A combined effect of the number of traders and the average investment might be captured in the total investments in a market. The variable „TINVEST“ captures the total real-money investment (0 was assigned to the virtual money markets). According to the hypothesis we should expect a negative coefficient for „TINVEST“.

[15] Nevertheless we should note that the average prediction error of the real-money markets in fact was slightly higher than in the virtual money markets.
[16] This is at least true if the traders have a similar degree of risk aversion.

4.2.4 Market Efficiency

In an efficient market the bid ask spread should be small. This is due to the fact that buying (selling) a contract is advantageous as long as the price is at least marginally below (above) the true value of the contract. The traders should compete for these possible trading surpluses causing the bid- and ask-queues to converge in the course of time. During this period of convergence the prices of the realized trades should approach their "true" values. Thus the prices should, at least in the end of the trading period, add up to 100%.

In fact, political stock markets are often not completely efficient. This can be attributed to market imperfections like transaction costs. Thus, it is not assured that prices add up to 100%. We use deviations from the efficient price of a unit-portfolio as an instrument for market efficiency. The variable „MKTEFF" captures the absolute difference between the market price (i.e. the sum of last traded prices) of the unit portfolio and the price of the unit portfolio at the bank. According to the hypothesis we should expect a positive coefficient for „MKTEFF".

4.3 Empirical Results

To find out about the factors of success of political stock markets in predicting the election outcome we run regressions on the mean average predictive error (MAE_PSM) of the conducted markets. Somewhat surprising we find most of the above discussed variables not to have a significant effect on the markets' predictive accuracy.

The variable with far the most predictive power is " MAE_POLL". Our regression model I (compare Table 5) that includes "MAE_POLL" delivers the predicted positive coefficient ($B=0.919$) that is highly significant ($T=18.030;p<0.001$). The poll errors explain almost 93% of the observed variance of the political stock markets' forecasting errors. Thus the main

result is that general electoral uncertainty is by far the most important factor of political stock markets' predictive accuracy.

When including other variables into our regression, most of the remaining variables have coefficients with the predicted sign but they are insignificant on the 10% confidence level. The only variable that turned out to have a significant effect on predictive accuracy is "MKTEFF" capturing the markets' efficiency. Including this variable in the regression leads to an increase in the explained variance (compare model II in Table 5). Other election characteristics, like the election level and the relative vote share size (as predicted by the model of Jacobsen et al. 2000) can not account for the predictive success.

One remark should be made with respect to the comparable study of Berg et al. (1997). Different from the American results, complexity of the market, as measured by the number of traded contracts, does not play a role in German markets. On the one hand, this might be at least partly due to the fact that our sample contains no markets with very low complexity, i.e. markets with only two or three contracts traded. On the other hand, Berg et al. (1997) did not include the variable that turned out to be most important in German markets, the poll error, in their regressions. It is well possible that this had a strong influence on the results.

5. Systematic biases

While, on the individual trader level, systematic biases and mistakes in political stock markets are well documented, it is thought that these biases do not influence the market prediction on the aggregate level. In particular, Forsythe et al. (1999, p. 88) found no obvious bias in the North American data on an aggregate scale. In contrast, Jacobsen et al. (2000) reported a series of Dutch markets, where an overvaluation of small contracts and an under-valuation of large contracts could be observed. They argue that structural differences between the American and the Dutch markets could be responsible for this finding. In the following we test for systematic prediction errors on the contract level in the German data set. The first

subsection is concerned with contract size effects whereas the second focuses on individual party effects.

5.1 Overconfidence and the structure of values

Jacobsen et al. (2000) suppose that the low predictive power of the Dutch political stock markets compared to U.S. events could be attributed to two factors: On the one hand the Dutch markets included more contracts than any other market (up to 10). The empirical result that the number of contracts in a market is negatively related to predictive power (Berg et al., 1997), might explain the effect – even if we found this effect not to be significant in the German data. On the other hand Jacobsen et al. (2000) observed a frequent overvaluation of small contracts and argue on behalf of a static model that the spread in the relative values of the vote shares might have caused this effect. Since there were only 5 Dutch political stock markets it was not possible to test the model's prediction empirically. Our comparatively large data set allows for such a test. Since the number of contract types traded in the German political stock markets is differing only slightly (between 5 and 7) whereas contract sizes were quite heterogeneous we are able to focus on the contract size-argument.

Jacobsen et al. (2000, p. 223-226) argue that there is a common value element in political stock markets, because the election outcome determining the value of the contracts is common. Traders tend to put too much weight on their own information and judgement and neglect that a low price for a contract indicates that other traders do not have favorable information about this party, thus they are overconfident. In combination with traders with cash constraints a phenomenon might occur that is similar to the well known "winner's curse" phenomenon, i.e. the average trader buys too many of the relatively "cheap" contracts and too few of the "expensive" ones. This phenomenon might cause parties with good electoral prospects to be undervalued and those with bad prospects to be overvalued. The model

predicts a negative correlation between the true vote shares and the price biases (prediction minus true vote share).[17]

In a first step we are interested in the question whether small contracts are overvalued and large contracts are undervalued. Therefore we are in the need of a measure dividing the contracts into these two categories. We define a contract to be "large" when the real vote share v_i of the corresponding party is larger than an average contract of the market and to be "small" when the real vote share is smaller than the market's average contract,

$$v_i \quad is \quad \text{"large"} \quad if \quad v_i > \frac{1}{K}$$
$$v_i \quad is \quad \text{"small"} \quad if \quad v_i < \frac{1}{K}$$

with K being the number of contracts in this political stock market. From 25 markets we have data on the predictions of 150 individual contracts. Using the above measure we can divide the data into 55 large contracts and 95 small contracts. Figure 1 displays the price of each contract reported by the organizers as the final prediction of the market and the election result of the corresponding party. Points above the 45° line indicate overvalued contracts and points below this line indicate undervalued contracts.

Figure1 about here

Indeed, 67.4% of all small contracts in the German data set turned out to be overvalued with a mean error of 0.31 (% of the vote shares) and large contracts are undervalued with a mean error of –0.45. Both effects, the overvaluation of small parties (T=1.656; p<0.051) and the undervaluation of large parties (T=-1.359; p<0.090) are significant on the 10% level. One might suspect the polls to be responsible for this systematic bias on the contract level. Yet, the

[17] This hypothesis is also in line with the experience of several market organizers (including ourselves) that a number of market participants concentrates on trading small contracts, since these allow comparatively high

mean poll prediction errors of both categories are not biased on the aggregate level (see Table 6). The effect is even more clear cut when we exclude an election with a market design error: In the Sachsen-Anhalt 1999 state election the right wing DVU party, which was attributed to the RoF contract, made it into the parliament[18]. We argue, that the participants were strongly influenced by the market organizers' decisions not to assign a separate contract for the DVU party what might have suggested to the market participants that the party is not expected to gain influence in parliament. It turned out that the participants of the market could not capture the success of the party and the prediction error for the (small) RoF contract was –9.3. The test results, including and excluding the Sachsen-Anhalt 1999 state election, are summarized in Table 6.

Table 6 about here

5.2 Judgement bias

Within political science and psychology two types of judgement failures, i.e. systematic biases with respect to the voter's view of an election campaign, are reported: the assimilation-contrast effect and the false consensus effect (compare Forsythe et al., (1992), p.1154-1156). The assimilation-contrast effect states that an individual's interpretation of information about the likelihood of a certain event occurring is influenced by the individual's preferences on this outcome. The false consensus effect states that there is a tendency to overestimate one's individual beliefs to be representative for the population. Both effects might be present in political stock markets thereby causing systematic price biases of party contracts. Such problems may arise whenever the group of active traders in a political stock market is significantly differing from the population with respect to party sympathies. The assimilation-contrast effect might cause the referring traders to buy the contract for an unrealistic high

yields (i.e. a high leverage effect) even when facing a cash constraint. Therefore the leverage effect might also result in an overevaluation of small and an undervaluation of large contracts.

[18] The RoF gained 15.3% of the vote shares compared to a market price of 6% (GEMW) and 6.5% (Wahl$treet).

price because of wishful thinking. As long as there is no systematic overrepresentation of a group of likely voters of a certain party it might be expected that the effects might cancel out. Systematic price biases may arise whenever there are misrepresentations of certain voting groups. The same effect may result from the false consensus effect in the case of a non representative sample.

In the context of political stock markets individual traders' errors and mistakes are well documented. However, it is unclear whether individual decision making based on biased judgements influences market prices or not. Using our German data set we are able to test for party specific biases of the prediction results on an aggregate level. Since we do not have data on the vote intentions for all German political stock markets we first analyze the distribution of vote intentions in a subset of German markets in order to set up hyposesis which party-contracts should be over-(under-)valued when a judgment bias of individual traders influences market prices on the aggregate level systematically. Assuming that the markets in the subset are representative for all German markets we test the hypothesis using the full data set on German political stock markets.

Empirical data on the vote intention/party sympathy of the participants of German markets is available in 5 cases. Table 7 reports the relative frequency of the vote intention of market participants in relation to the election result of a party. Values greater than one imply that traders who prefer a specific party are overrepresented in this market. It is easy to observe that traders in favor of CDU/CSU and SPD (large parties) are underrepresented and traders preferring FDP and Grüne (small parties) are overrepresented. Therefore, according to the judgement-bias-hypothesis, FDP and Grüne contracts should be overvalued and CDU/CSU and SPD contracts should be undervalued. Since traders that are likely voters of the PDS are not systematically misrepresented in the subject population there should be no systematic bias in the PDS prices.

Table 7 about here

The most striking party specific effect can be observed with the Grüne contract. The contracts are on average overpriced by 1.15 of the total vote share (T=5.024, p<0.001). This finding is in line with the small party effect of the total sample, because the election result of this party is attributed to the group of small contracts. The overpricing can also be observed for the FDP contract, yet, the effect is not significant. The contracts of CDU/CSU, the party with the highest vote shares on average, are under-priced by –0.77 of the total vote shares (T=-1.397; p<0.088). For the SPD, a large party contract, a systematic deviation from a zero mean can not be observed, yet, this may be influenced by the significant overprediction of the SPD by the pollsters. Even though the PDS was traded in a subset of only 16 elections as a separate contract, a systematic effect can be observed. The PDS, which is with regard to our definition, in 6 cases a large party and 10 cases a small party, is systematically undervalued by -0.52 of the vote shares (T=-2.244; p<0.020). This result is not in line with the judgement bias hypothesis but might be caused by the somewhat differing classification of this party as small or large. Table 8 gives an overview on all party specific effects.

Table 8 about here

Summarizing we find some empirical evidence in favor of the different judgement-bias-hypotheses, especially with respect to the Grüne party. Since this finding is also in line with the party size effects we discussed in the previous subsection it is hard to determine whether the overvaluation of the Grüne party is a result of misrepresentation or of the Grüne being a small party. Since we only have appropriate micro data for one market in our sample (Berlin 1999 GEMW) it is hard to answer this question. Handrich and Roericht (2001, p.19) showed at the example of this market that traders with party preferences did not pay higher prices for their house stocks than all other traders did. This might be taken as indication for the relevance of the party size effects in comparison to the judgement bias argument.

6. Conclusions

Prices from political stock markets have been used to predict the outcome of elections all across Europe. The stock market's predictive success is highly correlated with general electoral uncertainty. Nevertheless the market participants did not simply reproduce the latest poll results. Even though the political stock markets in our German sample performed well when compared to the corresponding polls, we were able to detect systematic biases on the contract level. We find small parties to be over- and large parties to be undervalued and this result not to be driven by the corresponding polls. This is in line with Jacobsen et al. (2000). Yet there is no evidence that markets with asymmetric vote shares cause larger prediction errors. Finally, we find party specific effects, most notably a significant overvaluation of the Grüne party. Thus, the market forecast might be improved by correcting for these effects.

Some open research questions remain due to the limited scope of the available data. We could not validate in how far the observed party specific effects are driven by judgemental biases. We could not resolve the discussion whether real money should be involved or lottery-like incentive systems are performing equally well since only 3 markets in our sample were no-money markets. The same is true for the comparison of market institutions. With the limited data of only 4 call markets in our sample we are not able to test this question empirically. It would also be fruitful to compare predictive accuracy of the market on the day of the poll release. Since our dataset includes the closing prices only, we can not draw conclusions for the quality of long term predictions of political stock markets.

Appendix A. Political system and political parties in Germany

Formally the President ("Bundespräsident") is Germany's highest political representative. In fact, the main policy guidelines are set by the Chancellor as head of the government. The German Chancellor is elected by the federal parliament. Similarly the heads of the state governments ("Ministerpräsidenten") are elected by the state parliaments.

Germany's political system is characterized by very pronounced federal structures. In principle all legislative sovereignty is allocated to the states of the Federal Republic of Germany. Exceptions from this principle have to be established in the German Constitution. There are a lot more exceptions than regularities in that respect. In fact the Federal Government owes the majority of legislative power. Nevertheless there are significant fields the state governments are responsible for exclusively. Besides that, the state governments are members of the Bundesrat, who has to approve laws that concern the states' interests. While the federal parliament ("Bundestag") is elected in four-year-intervals, the state parliaments usually have a five-year term of office. Both, state as well as federal elections produce a lot of interest in the media and in the public. That is why election markets have been organized for federal elections as well as for state elections.

Germany is a representative democracy, i.e. the public – or more precise: the persons entitled to vote - decide, who will represent their interest. Within elections, the voters regularly have two votes. The first vote decides on the question, which of the nominated candidates shall represent the constituency in parliament. The more important second vote decides on the relative strength of the parties in parliament and thereby, which party (or parties) will set up the government. While the first vote is devoted to a certain candidate, the second one is solely related to the party. That is why election markets in Germany were always contingent on the parties' shares of second votes.

There is one peculiarity of German Election Law that should be mentioned: the so-called „Five-Percent-Clause". This rule demands that, in general,[19] a party has to reach at least five percent of the second votes to enter a state or the federal parliament and prevents splinter parties from taking office.

The political scene in Germany after World War II has been dominated by two major parties: on the one hand the conservative party CDU/CSU (Christlich Demokratische Union/Christlich Soziale Union),[20] on the other hand the social democratic party SPD (Sozialdemokratische Partei Deutschlands). In spite of being a relatively small party, the Free Democrats FDP (freie Demokratische Partei) played a decisive role in German politics in the past by forming coalitions with CDU/CSU and SPD. During the early 1980's the Green Party (Die Grünen) started to establish in German parliaments. After the 1998 Federal Election the Greens formed a coalition with SPD and participated in the German Federal Government for the first time. After Germany's Reunification in October 1990 the socialist party PDS (Partei des demokratischen Sozialismus), the successor of the former SED (Sozialistische Einheitspartei), started running up in German elections, too. The PDS has been quite successful in Eastern Germany. The large share of votes in Eastern Germany (as well as some specific rules in German election law) allowed PDS to enter the German Bundestag. Finally it should be mentioned that during the last twenty years there were a number of right-wing extremist parties (DVU, Republikaner, NPD) running for elections in federal as well as regional elections with a somewhat limited success.

[19] There are two exceptions from this rule. On the one hand a party enters a parliament if at least three candidates win their local constituency even if the party as a whole gains less than five percent of the total votes. On the other hand in some states there are exceptions for parties representing the rights of minorities.
[20] CDU and CSU are practicing a close political union. While the CSU is running for parliament in the state elections of Bavaria only, the CDU covers all other regional elections. During Federal Elections both parties are running for parliament together.

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Tables and Figures

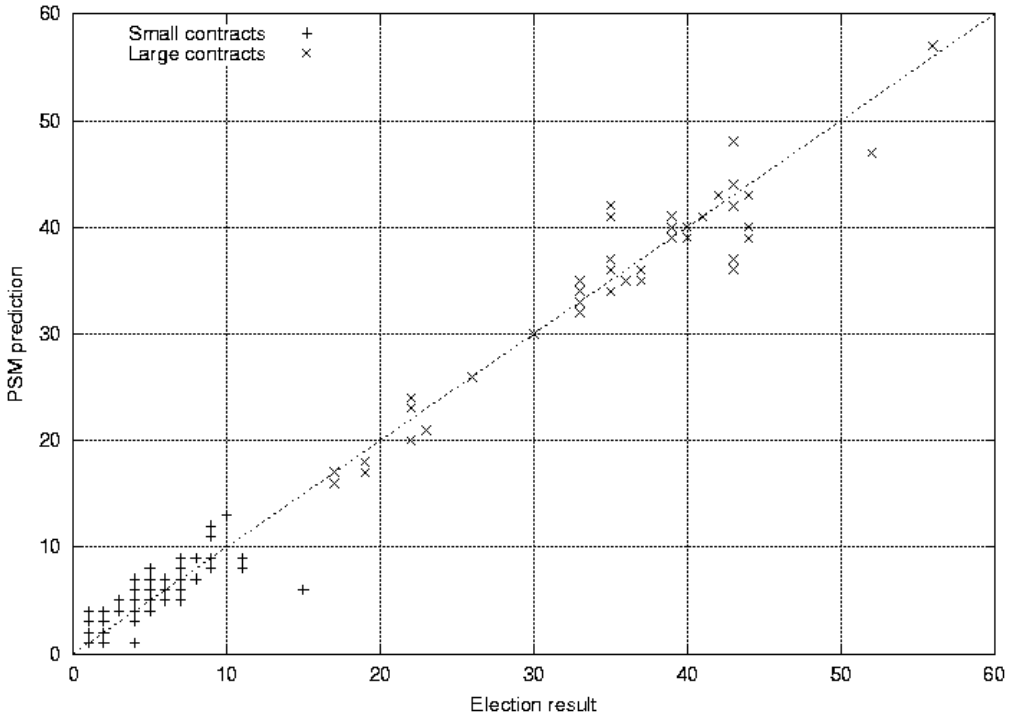

Figure 1: Election result of individual parties and political stock markets predictions on the contract level

Table 1: Election and market descriptions

No.	Year	Election	Market organizer	Market institution	Duration in days[21]	No. of Participants	Investiment Total in €	Investment/ Participant	No. of Contracts[22]	Theil Index	MAE PSM	MAE **Polls**
1	1990	Federal Election	Bonn	CDA	28	52	508.74	9.78	6	0.446	1.05	1.37
2			GEMW	CDA	24	62	770.01	12.42	6	0.446	1.22	1.37
3			Leipzig	CDA	18	26	194.29	7.47	6	0.446	1.62	1.37
4			Saarbrücken	POW	22[4]	21	138.05	6.57	7[6]	0.584	2.19	1.37
5	1991	Hessen	GEMW	CDA	16	44	700.47	15.92	6[5]	0.534	1.1	1.1
6	1994	Bayern	Passau	CMW	246[36]	100	1095.00[23]	10.95[3]	7[6]	0.685	1.73	1.43
7	1994	Federal Election	GEMW	CDA	153	400	14867.35	37.17	7	0.559	0.56	0.58
8			Passau	CMW	267[39]	193	2113.68	10.95	7	0.559	0.44	0.58
9			WirtschaftsWoche	CMD	58	500	0.00	0.00	7	0.559	0.59	0.58
10	1998	Sachsen-Anhalt	Wahl$treet	CDA	20	278	1163.70	4.19	6	0.245	3.62	3.67
11			Halle	CDA	48	37	562.42	15.20	6	0.245	3.28	3.67
12	1998	Federal Election	GEMW	CDA	141	112	3116.32	27.82	6	0.385	0.95	1.04
13			Wahl$treet	CDA	58	9482	50467.07	5.32	6	0.385	0.78	1.04
14	1999	Hessen	Wahl$treet	CDA		500	9535.00[4]	19,07[24]	5	0.391	2.72	2.53
15			GEMW	CDA	62	42	536.86	12.78	5	0.391	2.18	2.53
16	1999	Brandenburg	Wahl$treet	CDA		693	13215.51[4]	19,07[4]	6	0.396	1.13	1.62
17	1999	Sachsen	GEMW	CDA	65	28	744.44	26.59	6	0.575	1.00	1.90
18	1999	Berlin	Wahl$treet	CDA	47	561	10698.27[4]	19,07[4]	6	0.285	1.25	1.60
19			GEMW	CDA	46	200	5890.59	29.45	6	0.285	1.15	1.60
20	2000	Schleswig-Holstein	Wahlfieber	CDA	92	1200	18406.51	15.34	6	0.438	0.63	1.11
21	2000	Nordrhein-Westfalen	stern.de	CDA				19,07[4]	6[5]	0.512	1.16	1.74
22			Wahlfieber	CDA	54	528	0.00	0.00	5	0.350	0.76	1.74
23	2001	Baden-Württemberg	Prognosys	CDA	54	1228	21162.37	17.23	6	0.458	2.38	1.48
24			GEMW	CDA	40	44	1124.84	25.56	6	0.458	1.78	1.48
25	2001	Rheinland-Pfalz	GEMW	CDA	40	44	1124.84	25.56	5	0.343	1.16	0.74

Key: GEMW = German Election Market Workgroup; POW = Posted offer auction with weekly closings; CMW = Call market with weekly closings; CMD = Call market with daily closings; CDA = Continuous double auction; WirtschaftsWoche = German weekly; stern.de = online site of the German weekly Stern;
Source: The table is based on Brügelambert (1999a), unpublished information was provided by Arwed Crüger, Gerhard Ortner, and Carsten Schmidt.

[21] Numbers in brackets represent actual trading days in weekly call markets
[22] Numbers in brackets represent the number of contracts that where used to compare the PSM error to the poll error.
[23] Estimate on basis of the average investment per trader in the Passau federal election market
[24] Estimate on basis of the average investment of all state elections after the federal election of 1998.

Table 2: Allensbach Institute: Sunday Question, election forecast and official election result for the 1980 German federal election

Party	Share of votes in raw data	Allensbach Institute election forecast	Official election result
CDU/CSU	38.8	43.5	44.5
SPD	46.5	43.5	42.9
FDP	11.1	10.0	10.6

Table 3: Predictive accuracy of the average PSM compared to the average poll

			PSM			Polls		
#	Date	Election	No	MAE	MSE	No	MAE	MSE
1	1990-12-02	Federal Election1990	4	1.51	3.64	5	1.37	2.73
2	1991-01-20	Hessen1991	1	1.32	1.88	3	1.32	2.56
3	1994-09-25	Bayern1994	1	1.73	5.35	1	1.43	3.90
4	1994-10-16	Federal Election1994	3	0.53	0.53	6	0.58	0.51
5	1998-04-01	Sachsen-Anhalt1998	2	3.45	21.70	1	3.67	21.59
6	1998-09-27	Federal Election1998	2	0.87	1.34	5	1.04	1.89
7	1999-02-07	Hessen1999	2	2.45	9.75	4	2.53	11.24
8	1999-09-05	Brandenburg1999	1	1.33	2.25	2	1.63	6.01
9	1999-09-19	Sachsen1999	1	1.00	1.97	2	1.90	7.39
10	1999-10-10	Berlin1999	2	1.20	2.06	3	1.60	4.14
11	2000-02-01	Schleswig-Holstein2000	1	0.63	0.44	3	1.11	1.71
12	2000-05-01	NRW2000	2	0.96	1.18	4	1.74	4.43
13	2001-03-25	Baden-Württemberg2001	2	2.08	6.71	4	1.48	3.88
14	2001-03-25	Rheinland-Pfalz2001	1	1.16	1.42	2	0.74	0.77
		Average	1.86	1.44	4.30	3.21	1.58	5.20
		(Std. Dev.)	(0.95)	(0.78)	(5.66)	(1.53)	(0.77)	(5.50)

Table 4: Analysis Variables

Variable	Class	Description
Level of Election	Election Property	Dummy Variable: 1=Federal; 0=State
Number of Contract Types	Election Property	Number of contract types traded on the specific PSM; corresponds to the number of major parties and one RoF contract
Poll Error	Election Property	MAE of the average poll of the election
Asymmetric Vote Shares	Election Property	Homogeneity of the shares' size measured by the Theil coefficient.
Time Effects	Election Property	The number of month the market was conducted after the first election market in our sample
Floating Voters in East Germany	Election Property	Dummy Variable: 1=East German Voters; 0=No
Number of Traders	Market Property	Total numbers of traders in the market
Average Investment	Market Property	Average investment of traders in €, fantasy markets have the investment of 0 €
Absolute Investment	Market Property	Total investment of all traders in €, fantasy markets have the investment of 0 €
Market Institution	Market Property	Dummy Variable: 1=Continous double auction; 0=Call market
Market Error	Market Property	Absolute difference between the final price of the unit portfolio on the market and the price of the unit portfolio at the bank.

Table 5: OLS Models of Average Absolute Prediction Errors

Model		Unstandardized Coefficients B	Std. Error	T	Sig.	Adj. R^2
1	MAE_POLL	0.919	0.051	18.030	0.000	0.928
2	MAE_POLL	0.847	0.056	15.496	0.000	0.941
	MKTEFF	0.166	0.067	2.463	0.022	

a Dependent Variable: MAE_PSM

Table 6: Mean prediction error separated by small and large contracts

	PSM				Polls			
Contract (average election result)	n	Mean error(φ)	T	Sig. (1sd.)	n	Mean error(φ)	T	Sig. (1sd.)
Small (5.4%)	95	0.31 (1.85)	1.656	0.051	167	0.00 (1.58)	0.005	0.493
Large (36.1%)	55	-0.45 (2.43)	-1.359	0.090	96	0.01 (2.55)	0.048	0.481
Small w/o SA ´98	89	0.50 (1.26)	3.704	0.000	164	0.05 (1.45)	0.420	0.338
Large w/o SA ´98	49	-0.74 (2.10)	-2.478	0.009	93	-0.07 (2.46)	-0.265	0.396

Table 7: Relative frequency of self-reported vote intention/party sympathy of PSM participants divided by election result

No.	Election	Organizer	n	CDU /CSU	SPD	FDP	Grüne	PDS	RoF
2	Federal Election 1990	GEMW	51	0.85	0.49	1.05	4.10	0.00	0.00
5	Hessen 1991	GEMW	38	0.90	0.48	1.57	1.58	0.00	0.00
7	Federal Election 1994	GEMW	129	0.69	0.53	1.58	3.71	1.07	2.65
8	Federal Election 1994	Passau	188	1.05	0.62	2.16	2.19	0.36	2.11
19	Berlin 1999	GEMW	133	0.31	0.94	2.05	2.96	1.44	0.32

Table 8: Mean prediction error separated by party

	PSM				Polls			
Contract (average election result)	n	Mean error(φ)	T	Sig. (1sd.)	n	Mean error(φ)	T	Sig. (1sd.)
CDU/CSU (38.5%)	25	-0.77 (2.76)	-1.397	0.088	45	-0.37 (2.89)	-0.857	0.198
SPD (34.9%)	25	0.24 (2.27)	0.530	0.301	45	0.84 (2.29)	2.470	0.009
PDS (10.1%)	16	-0.52 (0.92)	-2.244	0.020	24	-0.75 (0.96)	-3.884	0.001
FDP (6.7%)	25	0.15 (1.39)	0.533	0.299	45	-0.14 (1.60)	-0.604	0.275
B90/Grüne (7.4%)	25	1.15 (1.15)	5.024	0.000	45	0.42 (1.30)	2.157	0.018
Republikaner (4.0%)	7	1.16 (1.19)	2.581	0.021	11	0.53 (0.52)	3.377	0.004
RoF (4.4%)	25	-0.55 (2.78)	-0.987	0.167	45	-0.44 (1.85)	-1.582	0.061
SPD w/o SA ´98	23	-0.28 (1.44)	-0.926	0.183	44	0.72 (2.17)	2.212	0.016
RoF w/o SA ´98	23	0.19 (1.12)	0.820	0.211	44	-0.26 (1.42)	-1.199	0.118